EC441: Lab 7

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7.0 Prelab

Question 5.3

Step	N	t	u	v	w	y	z
0	x	-	-	3,x	6,x	6,x	8,x
1	x,w	-	9,w	3,x	6,x	6,x	8,x
2	x,w,u	11,u	9,w	3,x	6,x	6,x	8,x
3	x,w,u,t	7,v	9,w	3,x	6,x	6,x	8,x
4	x,w,u,t,v	7,v	9,w	3,x	6,x	6,x	8,x
5	x,w,u,t,v,y	7,v	9,w	3,x	6,x	6,x	8,x
6	x,w,u,t,x,y,z	7,v	9,w	3,x	6,x	6,x	8,x

Question 5.5

Dest	Cost	Next Hop
u	6	x
v	5	x
x	2	x
y	2	x

Question 5.7

Part a)

Dest	Cost	Next Hop
u	7	w
w	2	w
y	2	w

Part b) The link between x & w goes down

Part c) The cost of the link between x & y goes to 6.

Question 6.8

Part a) Utility, $U = Np(1-p)^{N-1}$. To find the optimal p, find the derivative of U with respect to p and solve for p when it is equal to 0. So,

$$\frac{dU}{dp} = N(1-p)^{N-1} - N(N-1)p(1-p)^{N-2}$$

Then, when $\frac{dU}{dp} = 0$

$$\begin{aligned} N(1-p)^{N-1} &= N(N-1)p(1-p)^{N-2} \\ 1-p &= (N-1)p \\ 1 &= Np \\ p &= 1/N \end{aligned}$$

Thus, the optimal value for p is $\frac{1}{N}$.

Part b)

$$U(1/N) = (1 - \frac{1}{N})^{N-1}$$

Now, taking the limit as $N \to \infty$,

$$\lim_{N\to\infty} (1 - \frac{1}{N})^{N-1} = \frac{1}{e}$$

Using the fact that $\lim_{N\to\infty}(1 - \frac{1}{N})^N = 1/e$.

Question 6.10

Part a) Let $P[S]$ represent the probability that a given time slot is successful. Then,

$$\begin{aligned} P[S] &= P[\text{only A or B is successful}] \\ &= (1 - p_A)p_A + (1 - p_A)p_A \\ &= p_A - p_B p_A + p_B - p_A p_B \\ &= p_A + p_B - 2p_A p_B. \end{aligned}$$

Part b) Let $P[A]$ be the probability that for a given time slot, A is successfully sent. Thus, $P[A] = (1 - p_B)p_A$ and $P[B] = (1 - p_A)p_B$. Then we can show that the ratio of $P[A]$ to $P[B]$ is less than 2.

$$\begin{aligned} \frac{P[A]}{P[B]} &= \frac{(1 - p_B)p_A}{(1 - p_A)p_B}, let p_A = 2p_B \\ &= \frac{1 - p_B)2p_B}{(1 - 2p_B)p_B} \\ &= 2\frac{1 - p_B}{1 - 2p_B}. \end{aligned}$$

$2\frac{1-p_B}{1-2p_B} < 2$ because $\frac{1-p_B}{1-2p_B}$ is less than one.

If $\frac{P[A]}{P[B]} = 2$, then,

$$\begin{aligned}
2 &= \frac{(1-p_B)p_A}{(1-p_A)p_B} \\
2(1-p_A)p_B &= p_A - p_Ap_B \\
2p_B &= p_A + p_Ap_B \\
0 &= p_A + p_Ap_B - 2p_B \\
0 &= 1 + p_B - 2\frac{p_A}{p_B} \\
\frac{p_A}{p_B} &= \frac{1+p_B}{2}
\end{aligned}$$

Thus p_A and p_B should be chosen so that their ratio is $\frac{1+p_B}{2}$.

Additional Question 1

Part a) If the link from B to C fails, B will send an update to A. A will get an update from B and see that it is an update from the next hop, and send an update back to B, with a cost of 2. B will get this update and and send an update to A about its increase cost. This update will cause A to update andd repeat the process.

Part b) Probability is 1.

Part c) Probability is 1.

Additional Question 2 At t_1 C will send out a triggerd update to A and B notifiying them about the topology change, both with sequence numbers 1. A will then send a packet to B and vice versa, both packets having sequence numbers 1. Also at t_1, D will send an update to E, telling about the link failure, with sequence number of 1. When the link is restored at t_2, C and D will sent out lsp's to their neighbors, all with a sequence number of 1, and the same sequence of events will occur as before.

7.1 Static Routing

Question 1 The route does not change because static routing tables do not change.

Question 2 The route does not change becuase static routing tables do not change.

7.2 Distance Vector Routing

Question 3 Row 0 in the table has the following elements: 0, 1, 1, 1, 6, 6, 6. This lists the next node to hop to in order to reach node j, where j is the destination node.

Question 4 At $t = 1.0s$, the link between Nodes 4 & 5 fails and at $t = 3.0s$, it is restored. The failure of this link causes both Node 4 & 5 to send updates about their neighbors and costs to all other nodes. Once the update reaches Node 0, it stops sending packets to Node 6 and instead delivers packets to Node 4 by way of Nodes 1,2, & 3.

Question 5 The percent overhead is 24.18%.

Question 6 It takes about 0.05 seconds for routing tables to converge. 18 routing control packets are generated. The following table shows the global routing table after the link between Node 4 & 5 goes down. Element ij refers to source node i and destination node j, where each elemnt as the format next hop, distance to destination.

	0	1	2	3	4	5	6
0	-	1,1	1,2	1,3	1,4	6,2	6,1
1	0,1	-	2,1	2,2	2,3	0,2	0,3
2	1,2	1,1	-	3,1	3,4	1,3	1,4
3	2,3	2,2	2,1	-	4,1	2,5	2,4
4	3,4	3,3	3,2	3,1	-	3,6	3,5
5	6,2	6,3	6,4	6,5	6,6	-	6,1
6	0,1	0,2	0,2	0,3	0,4	5,1	-

7.3 Link State Routing

Question 7 Within in ther first 0.5 seconds, nodes are sending updates about ther nieghbor so that each nodes gains information about the topology of the network. At $t = 1.0s$, the link betwe Nodes 4 and 5 fails and at $t = 3.0s$, it recovers. The route changes because the failure of the link forces Node 4 & 5 to update their tables and send out ann update to all other nodes.

Question 8 The percent overhead is 36.518%

Question 9 It takes 0.06 seconds for the rounting tables to converge. 24 routing control packets are generated. Link State Routing take time to initialize and longer time to recover from link failure & generates more packets.